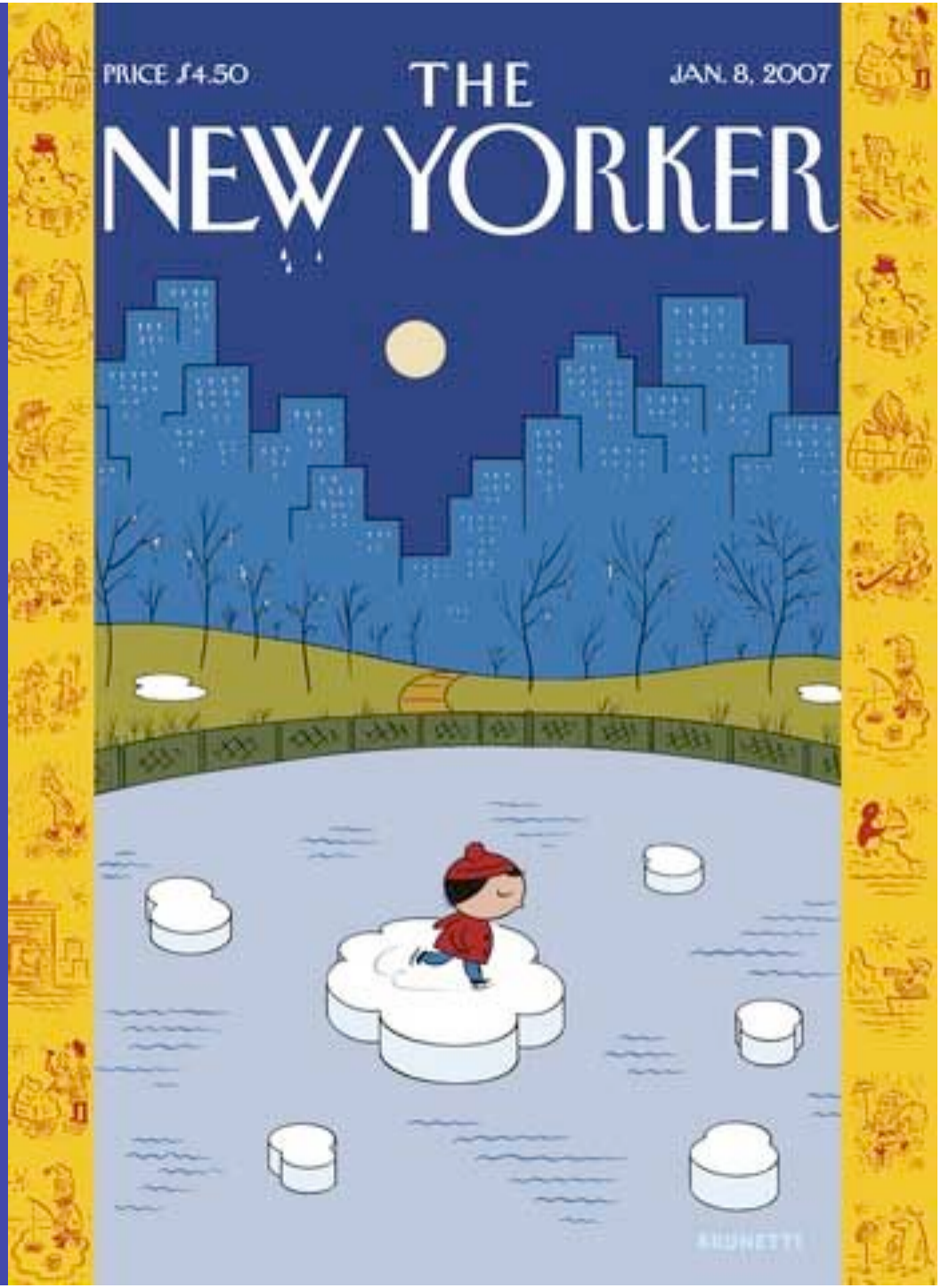
Model Panel Discussion

Dorothy Koch
Sunling Gong
Mark Flanner

Arctic Workshop
New York
January 2007



Model Panel Discussion

Dorothy Koch, Sunling Gong, Mark Flanner

Model uncertainties as well as global warming are amplified in the Arctic:

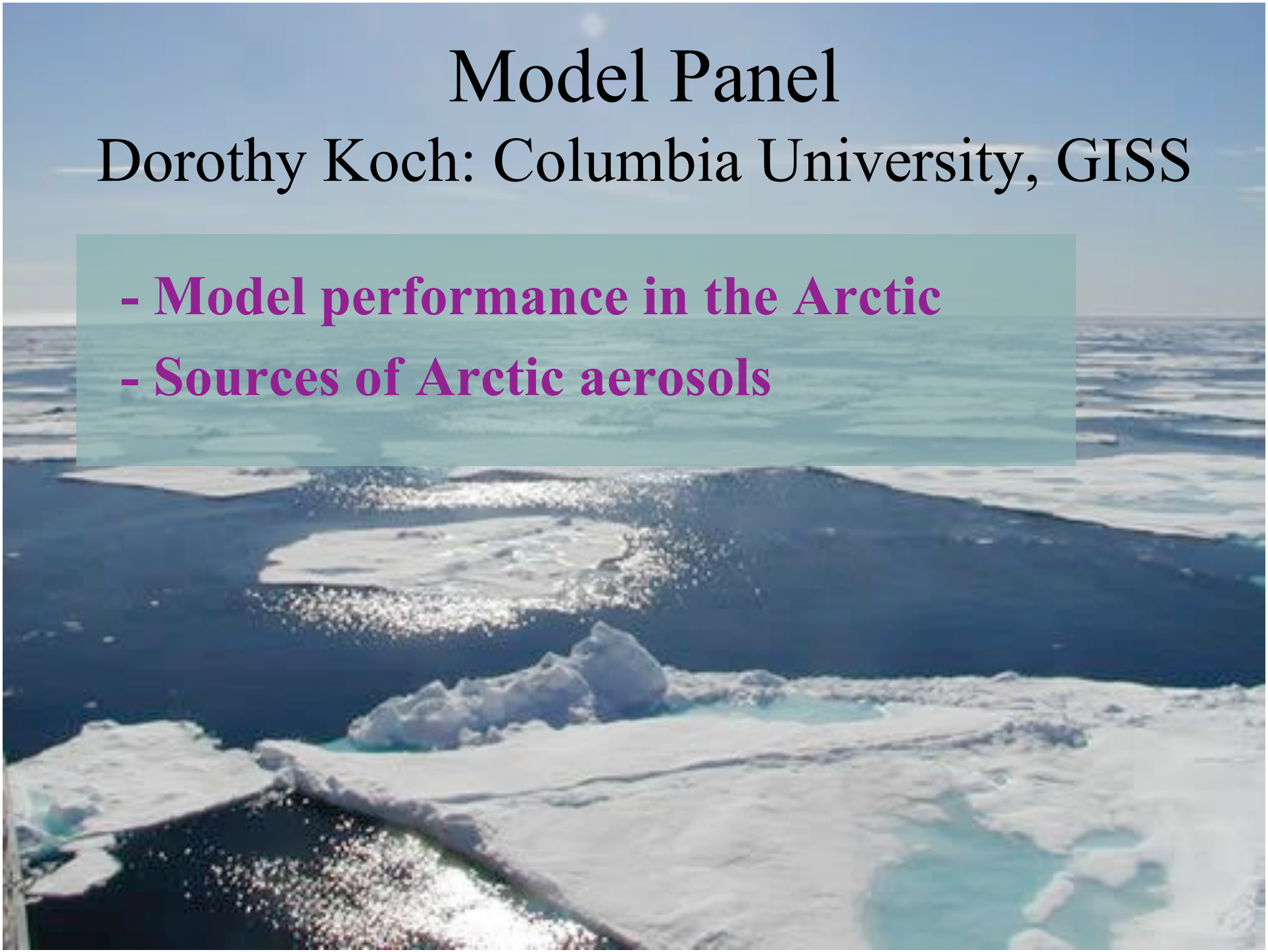
i) Emission inputs (especially for fires)

ii) transport to Arctic

iii) removal in the Arctic environment

iv) parameterization of climate effects

***What measurements would help most to constrain models?**

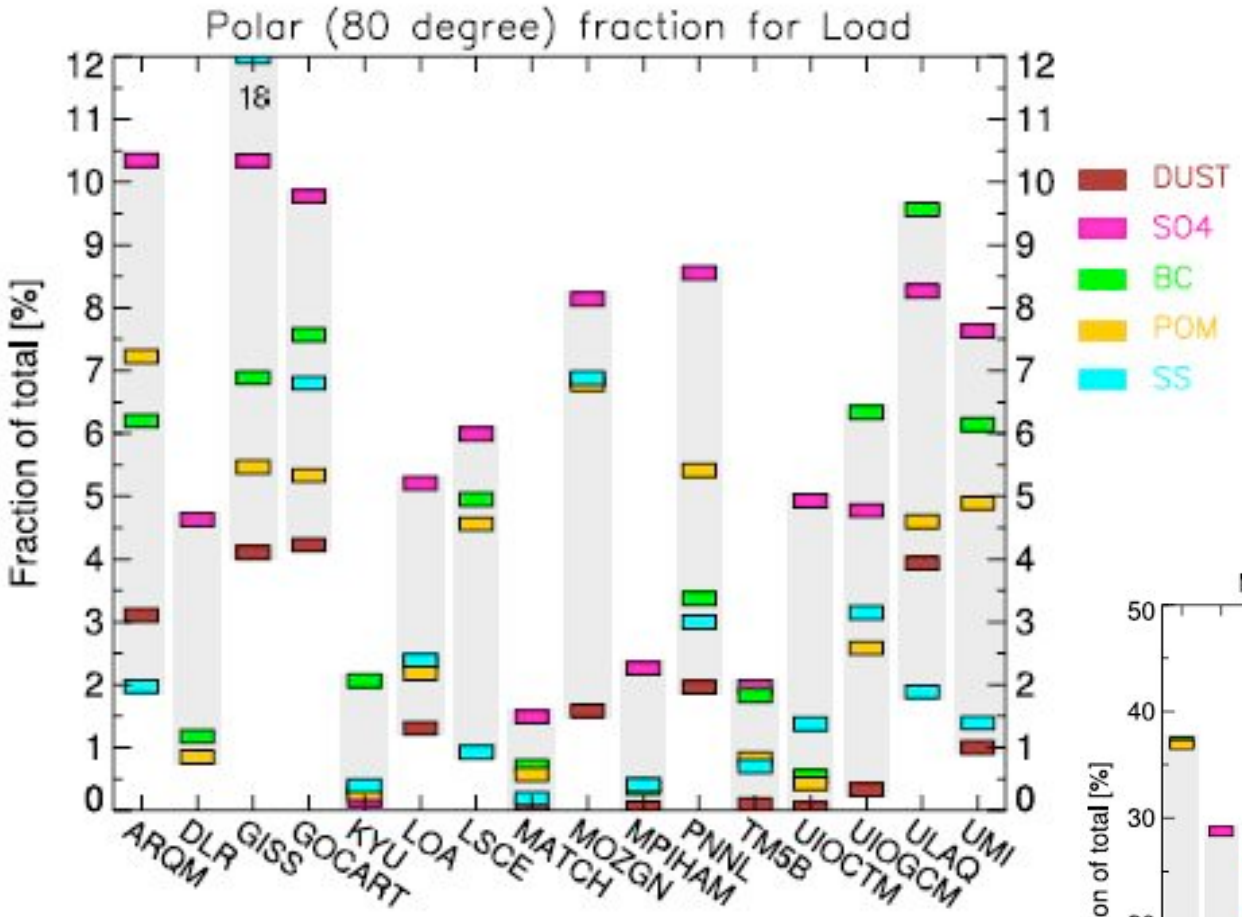


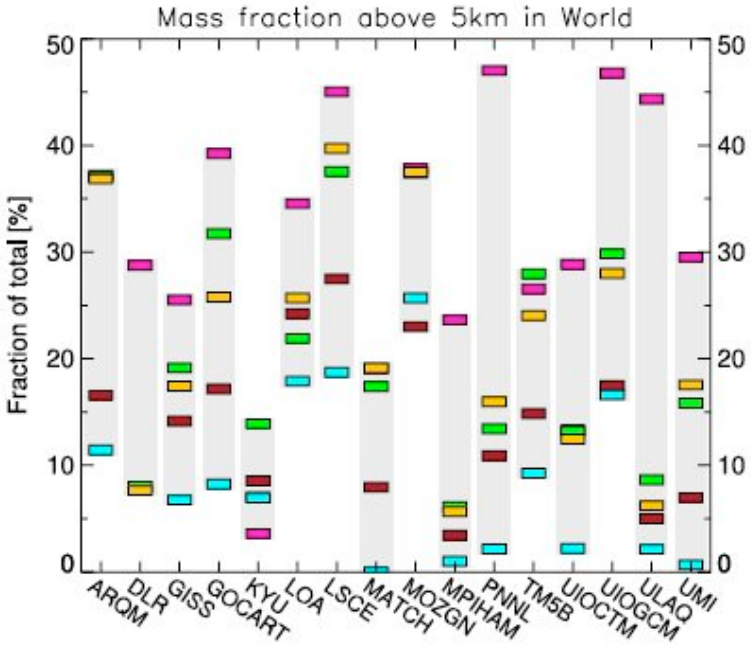
Model Panel

Dorothy Koch: Columbia University, GISS

- **Model performance in the Arctic**
- **Sources of Arctic aerosols**

Where do (AeroCom) models distribute their loads?





Textor *et al., ACP*, 2006

AeroCom BC models in Denali and Barrow Alaska

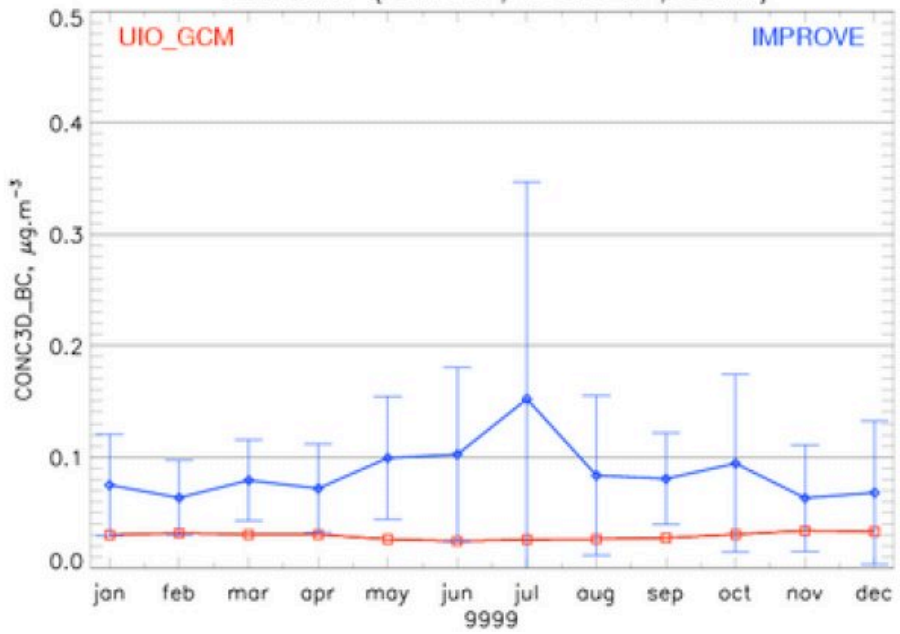
Denali

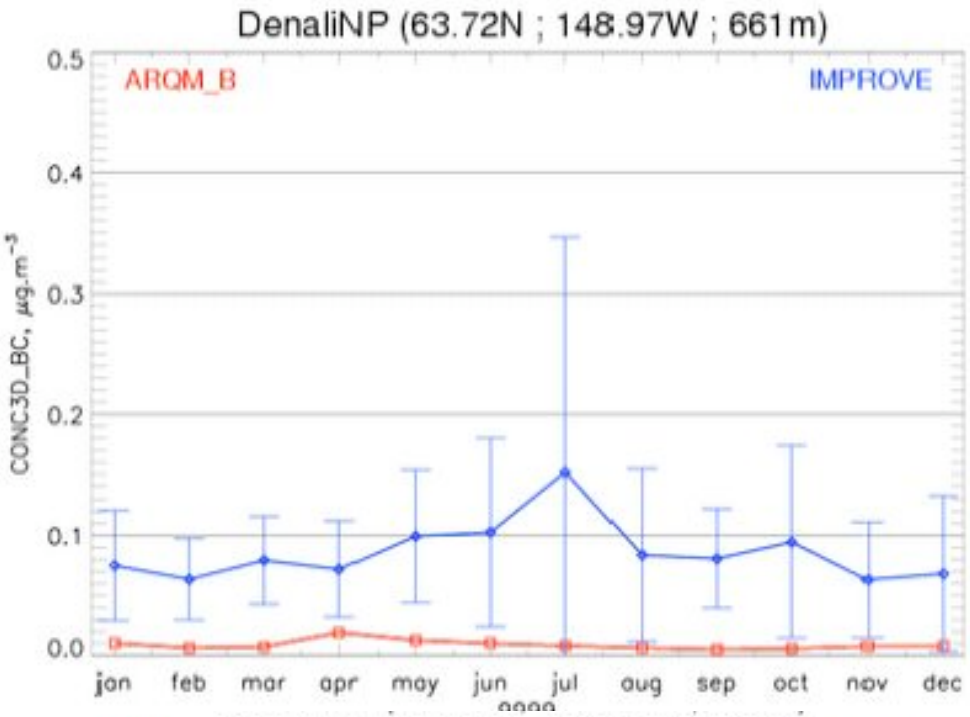
Barrow

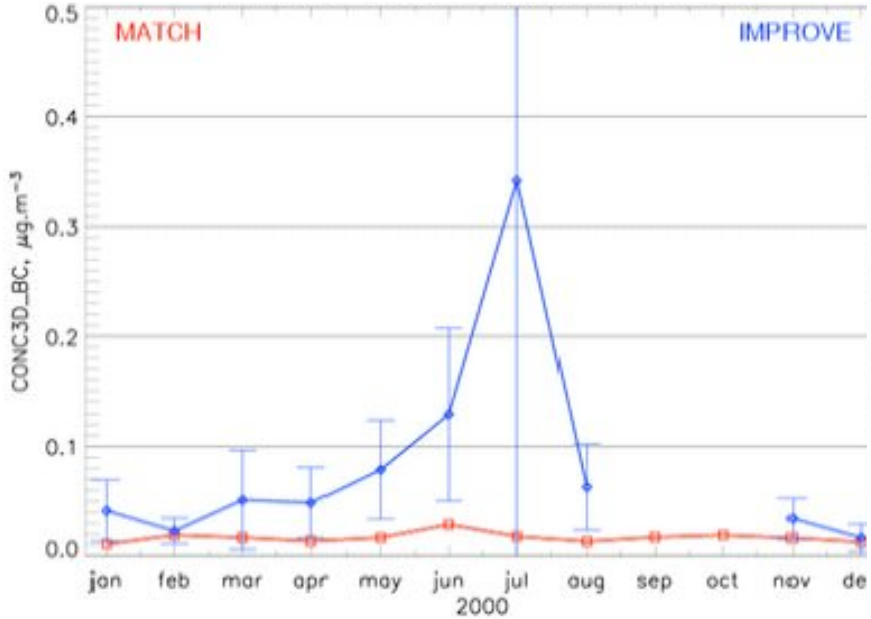
The unexamined life is not worth living

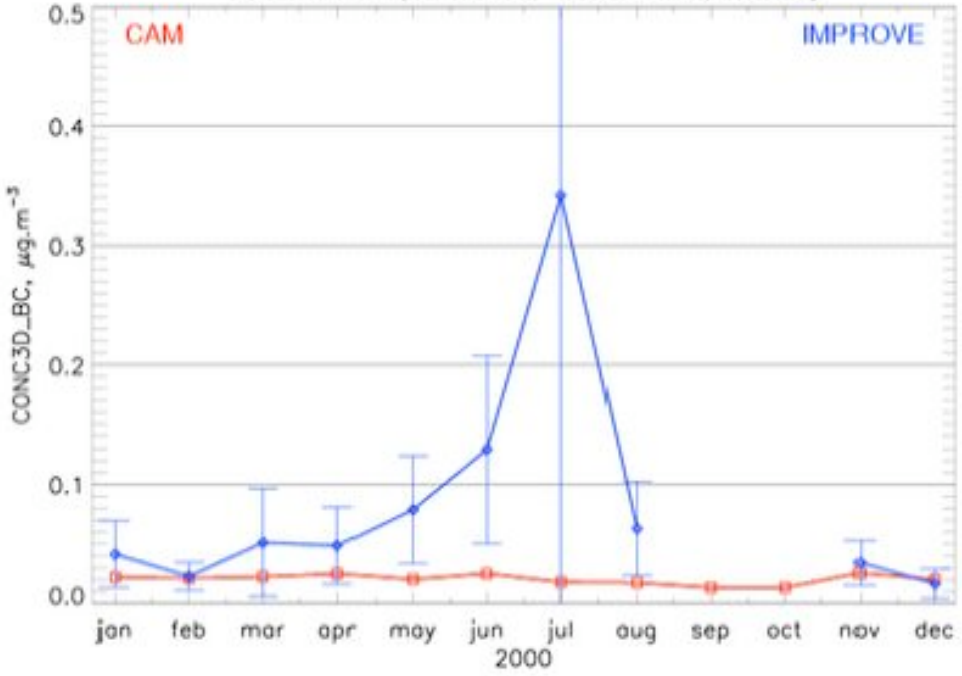
-Socrates

BC Models in Denali, Alaska

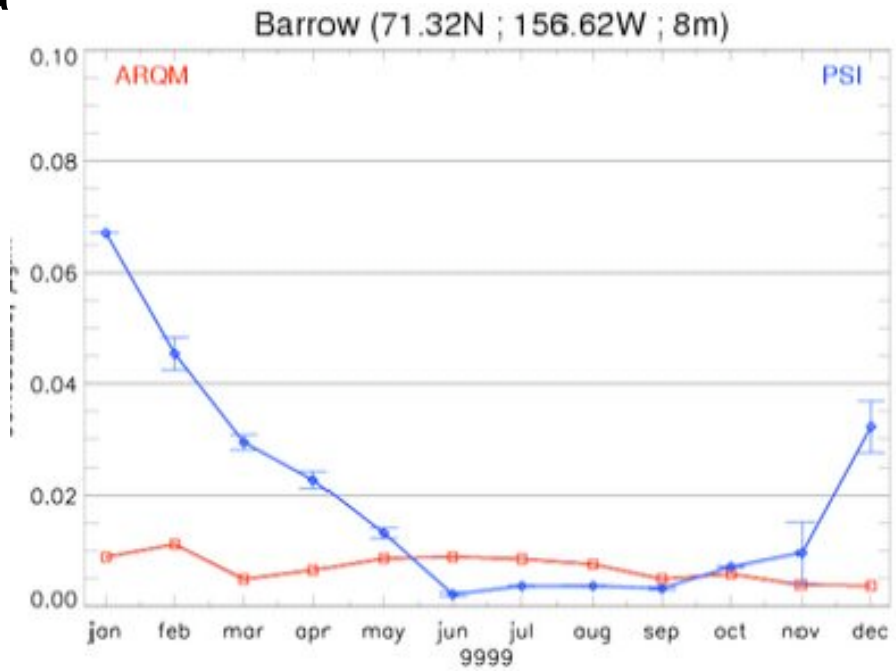


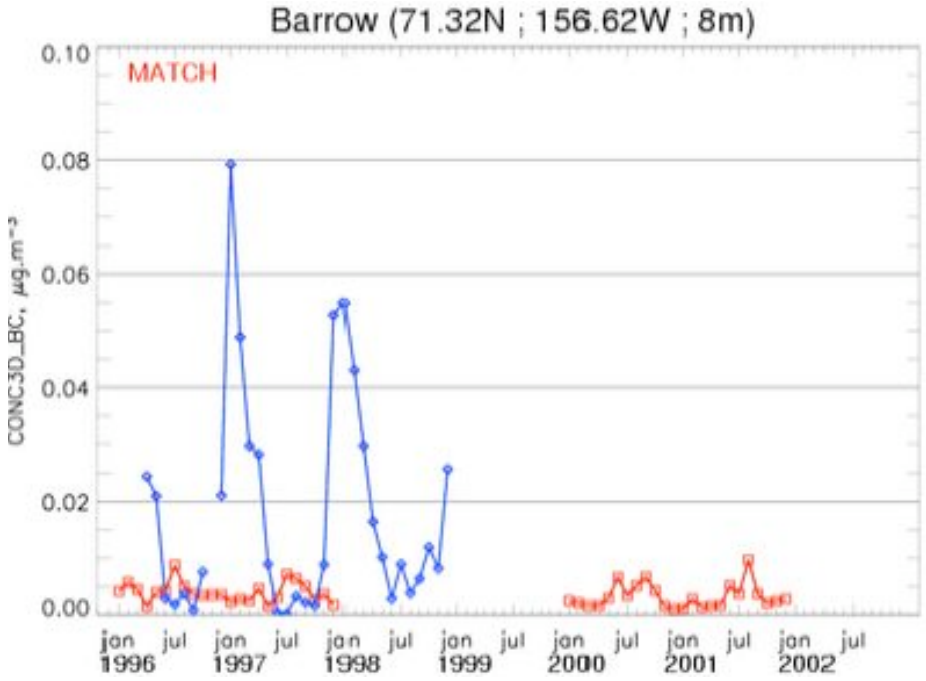


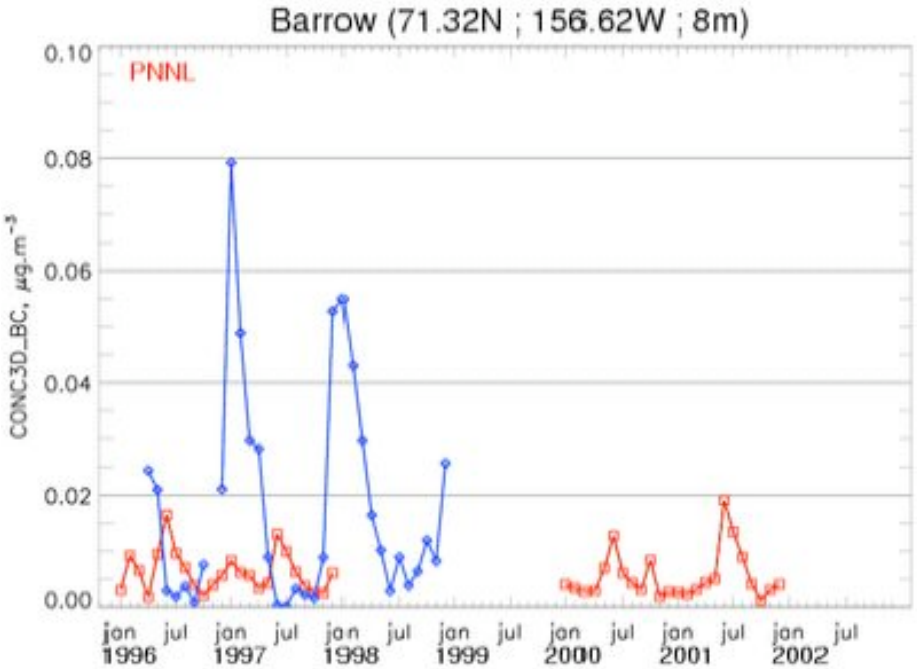




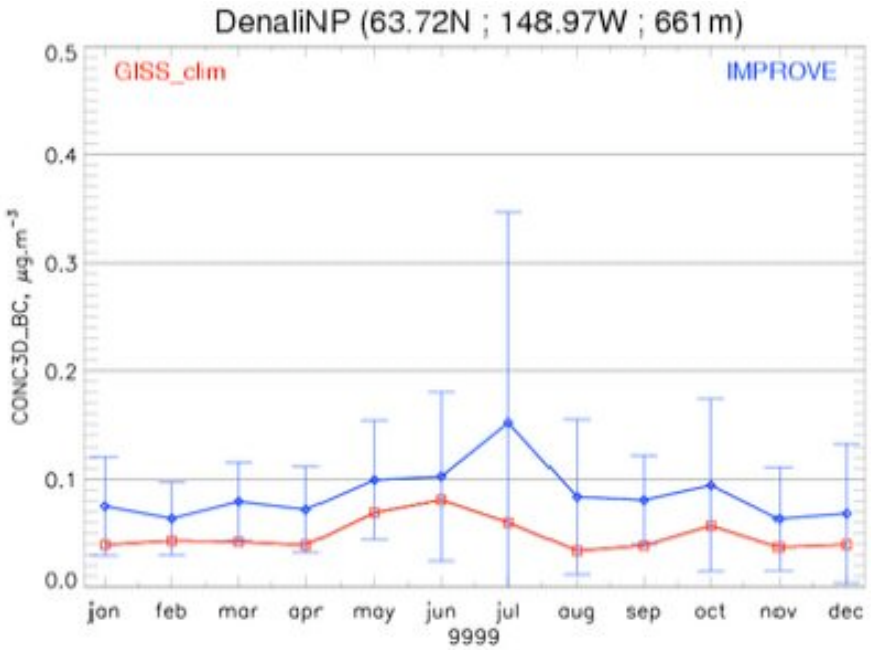
BC Models in Barrow, Alaska

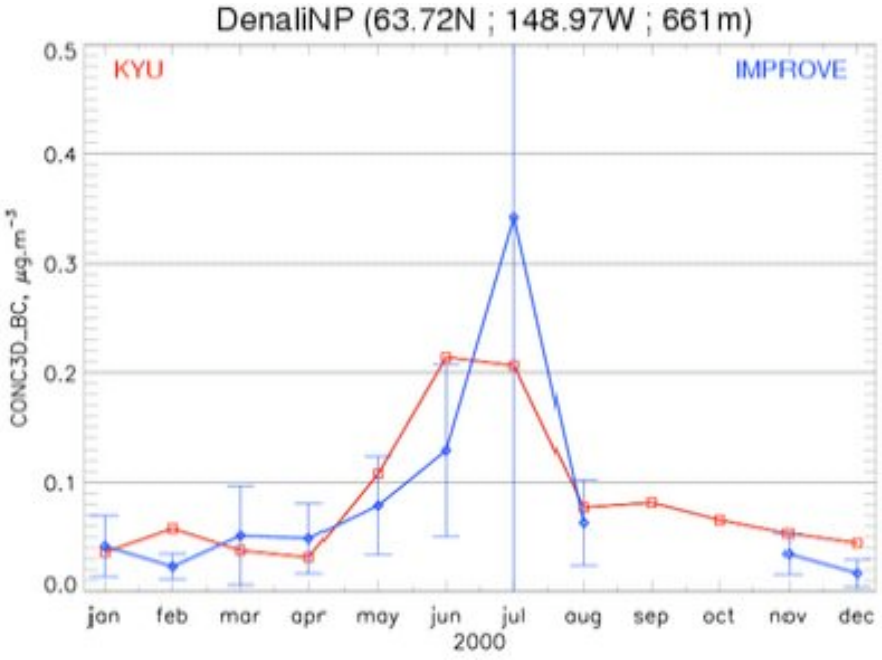


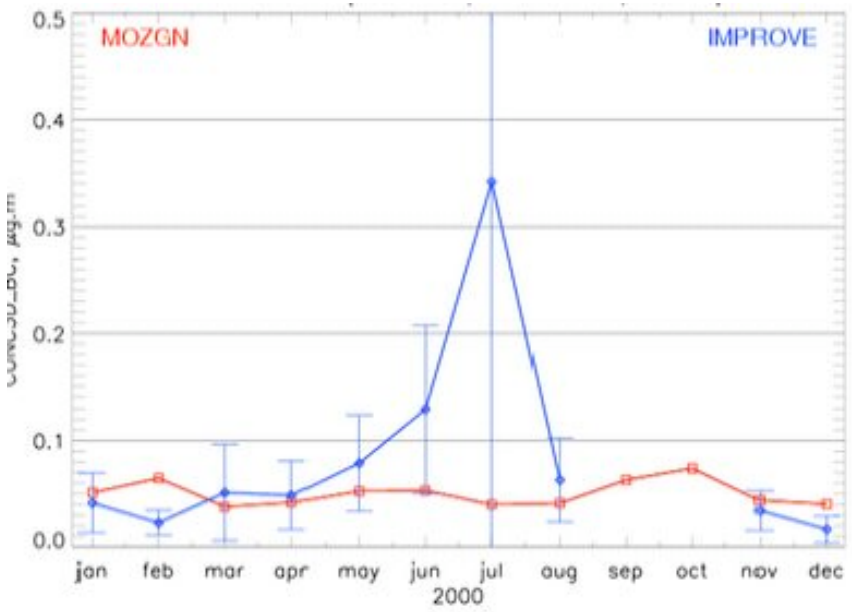




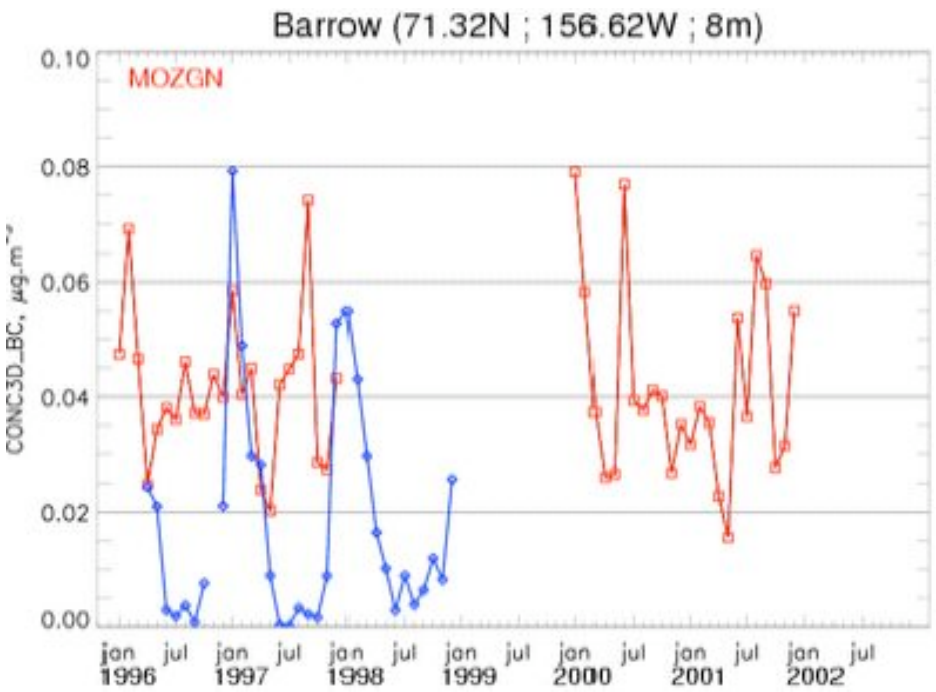
BC Models in Denali, Alaska

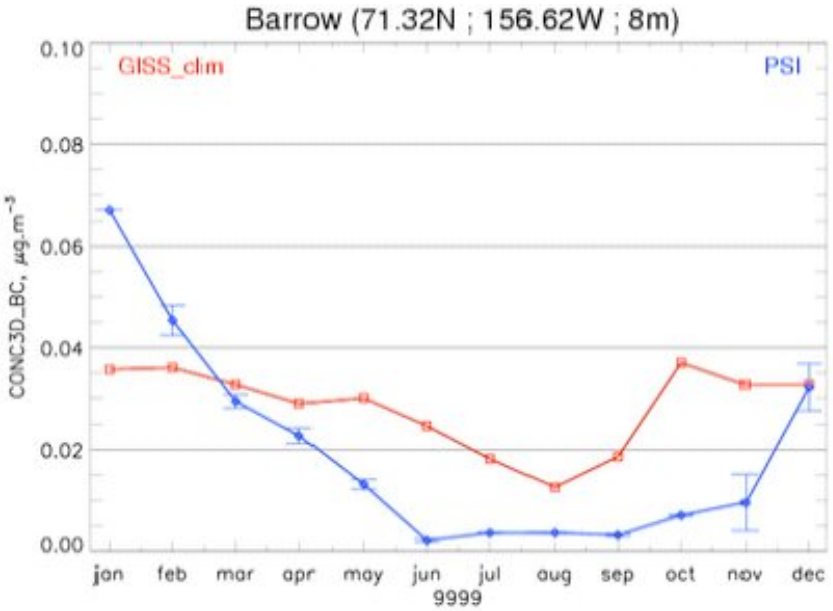


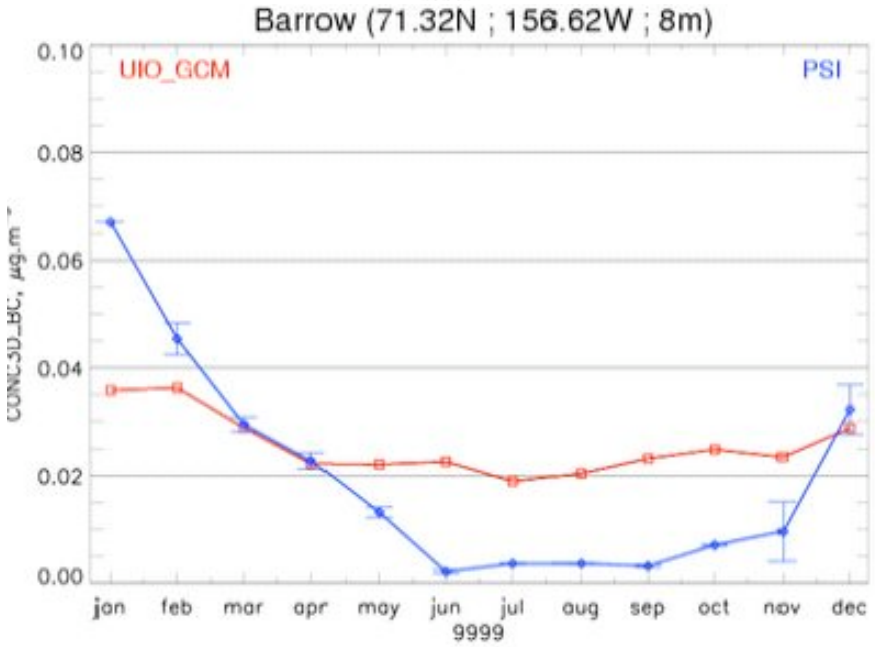


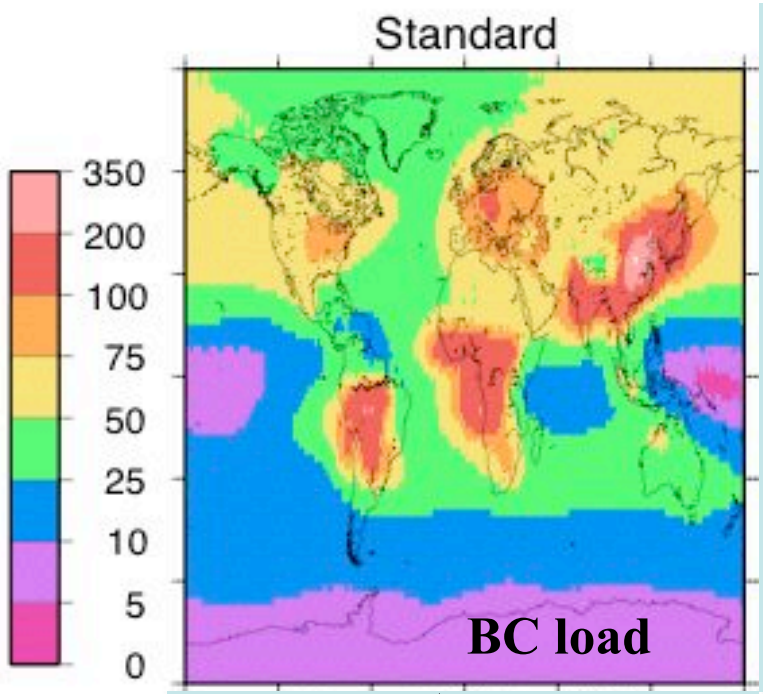


BC Models in Barrow, Alaska

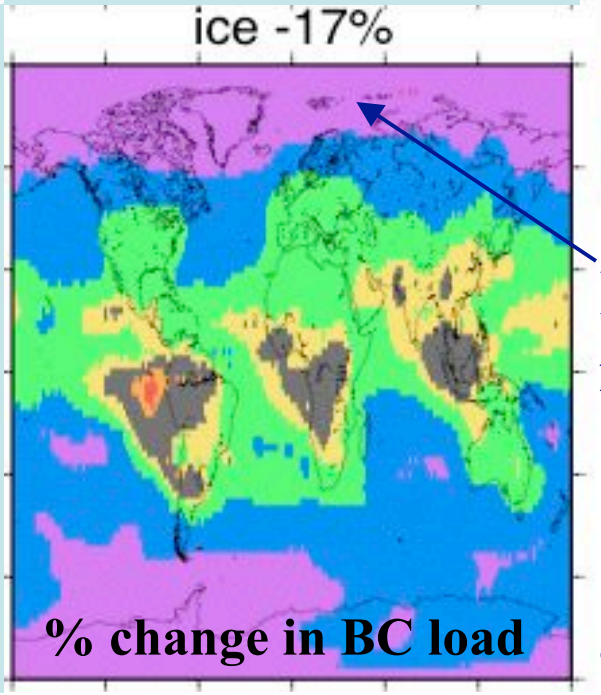


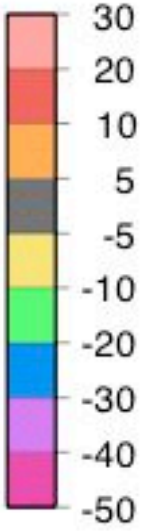






% BC load change for 40% ice scavenging





%

Standard BC load assuming 5% ice scavenging (relative to rain)

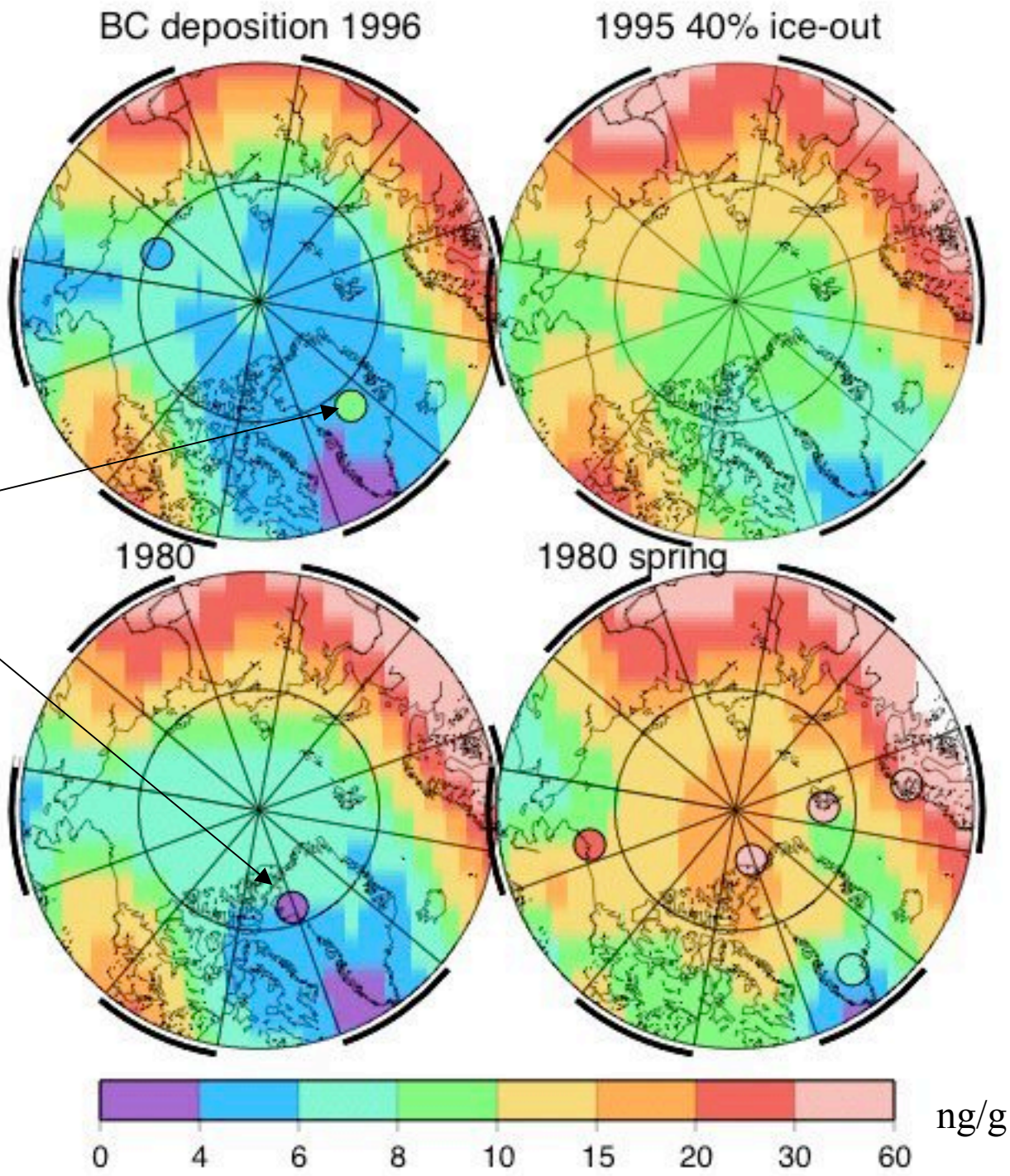
Enhancing ice removal has big effect at the poles.

(Note: GISS model has large fraction of ice-clouds)

BC snow concentration

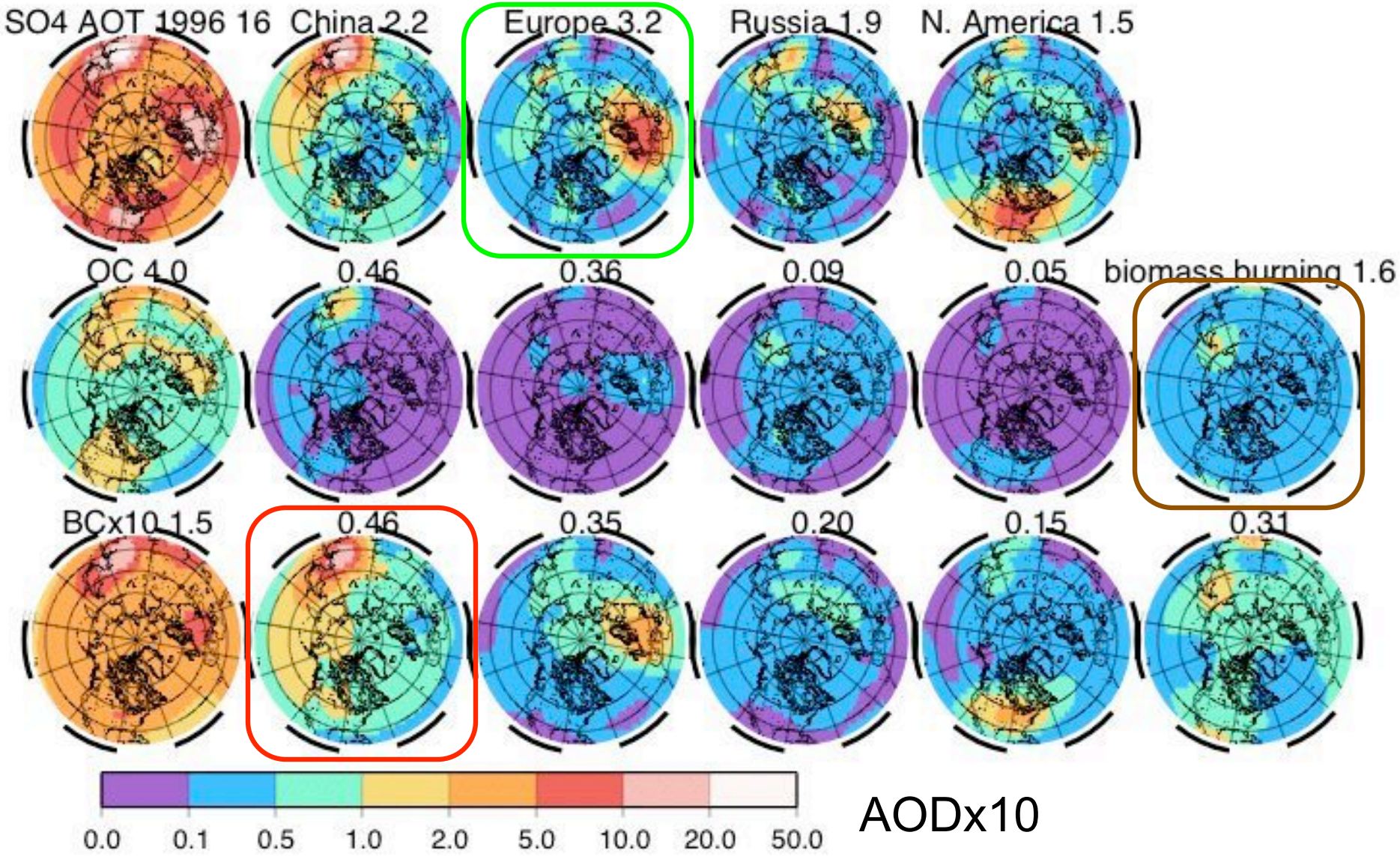
Observations compiled by Flanner et al., submitted

GISS model Arctic BC is generally smaller than observed



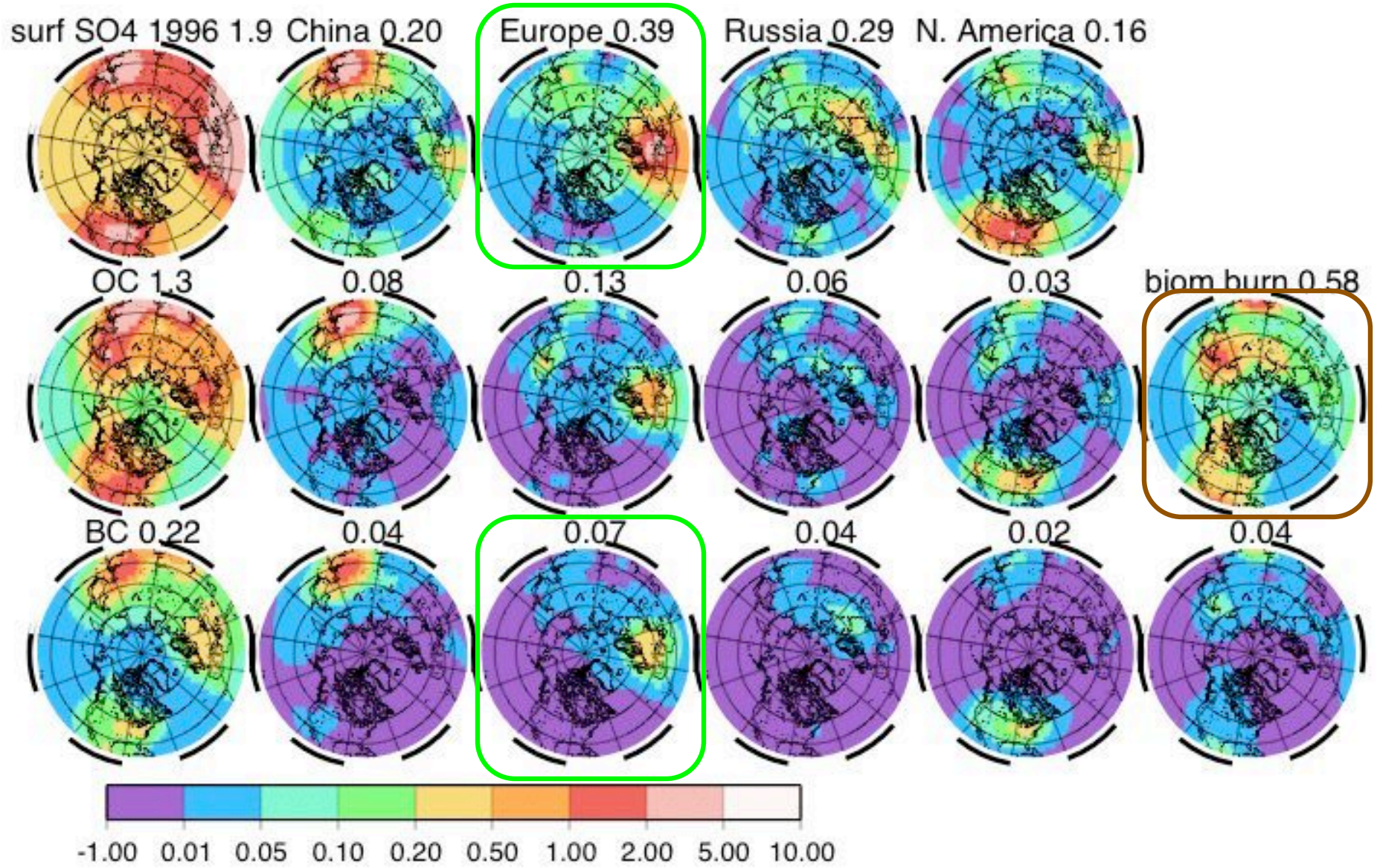
Arctic **AOD** origins: GISS model

Koch and Hansen, JGR (2005); Koch et al., JGR, in press



Arctic **surface** concentration origins: GISS model

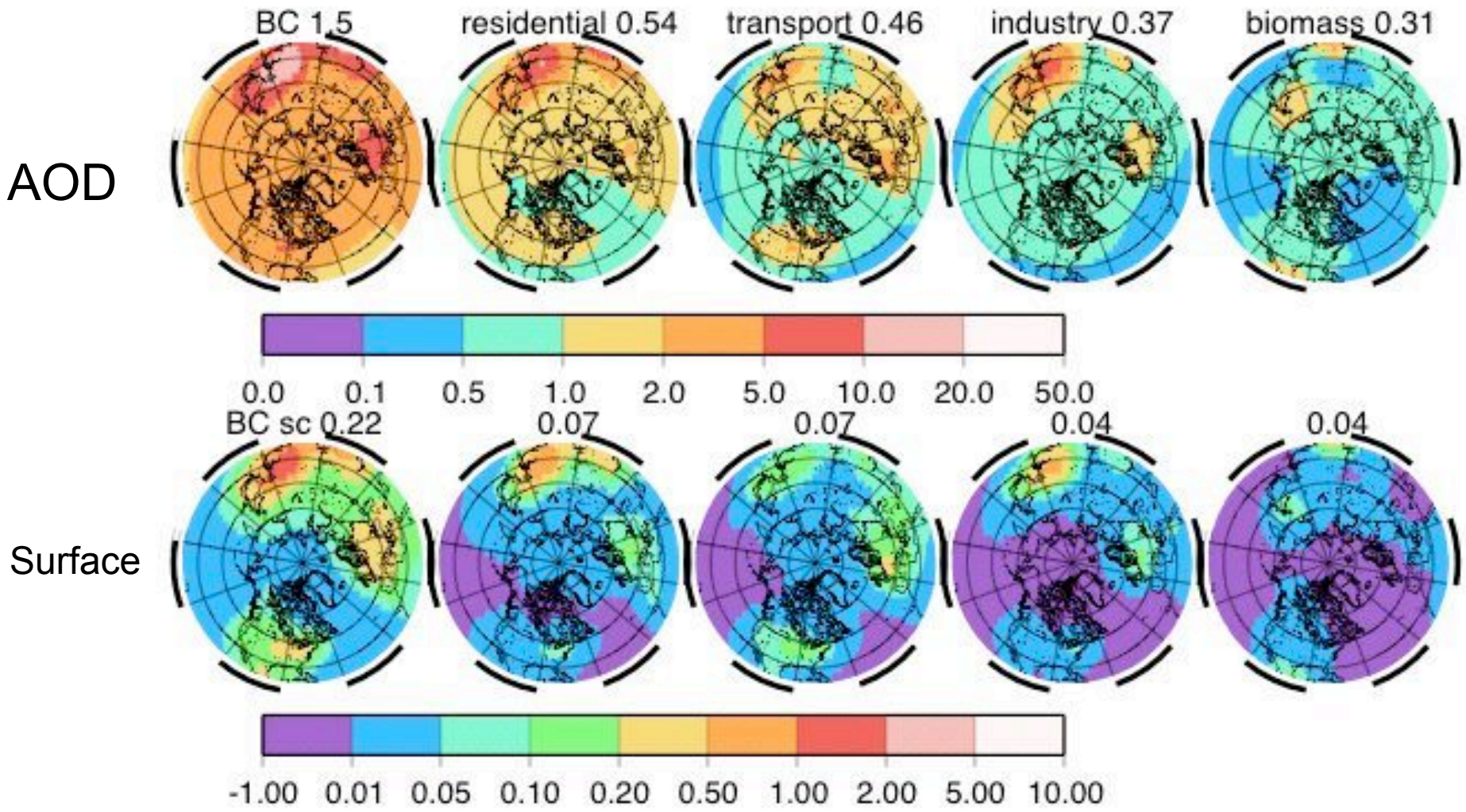
Koch and Hansen, JGR (2005); Koch et al., JGR, in press



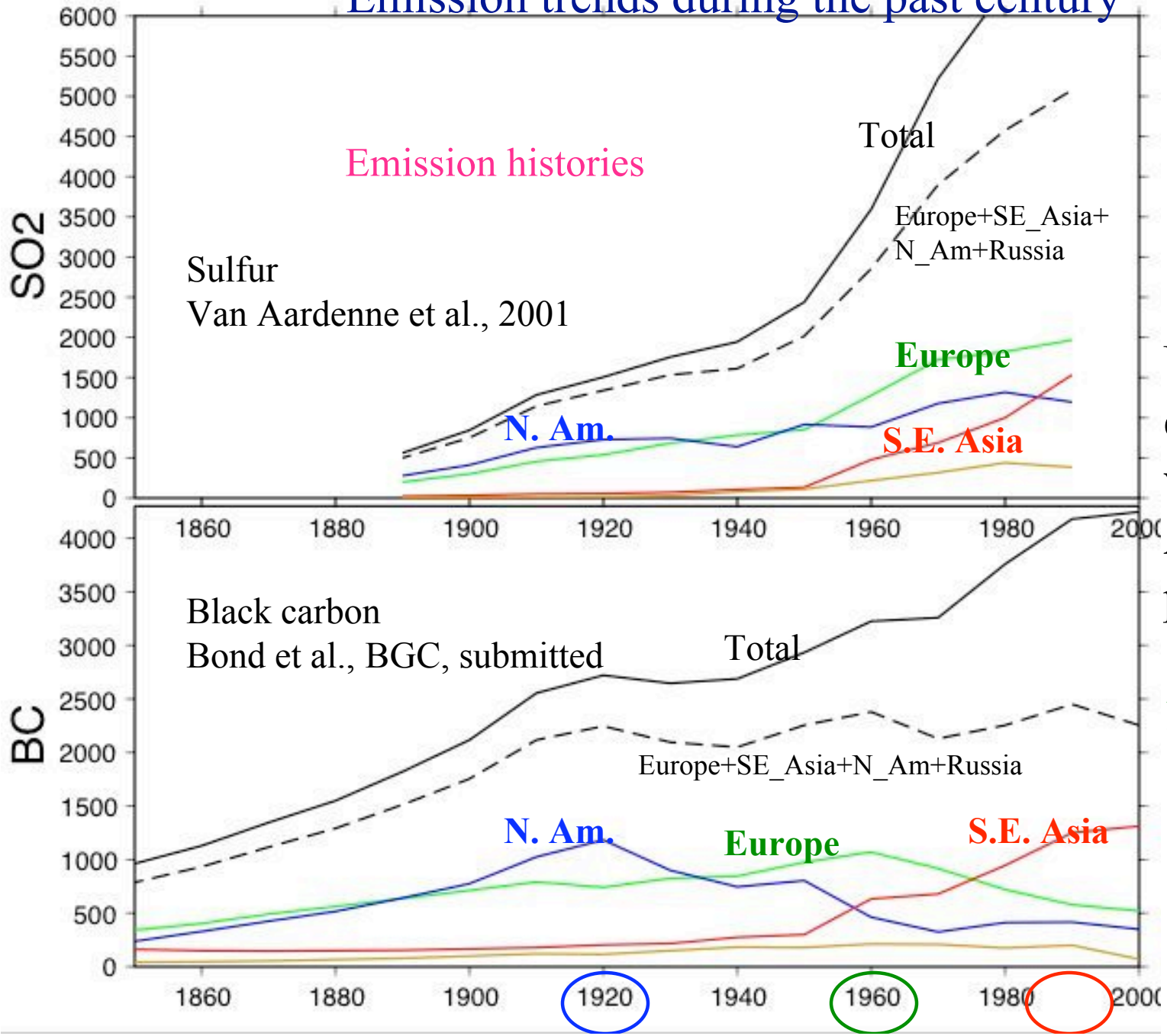
Sectoral sources

Arctic BC sectoral origins: GISS model

Koch et al., JGR, in press

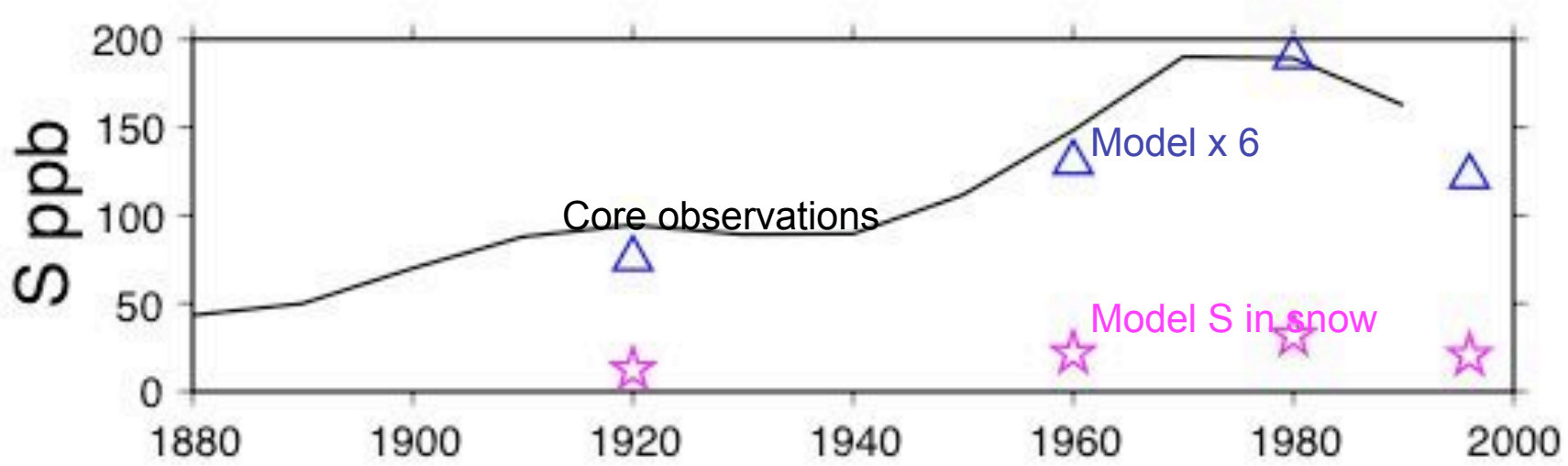


Emission trends during the past century

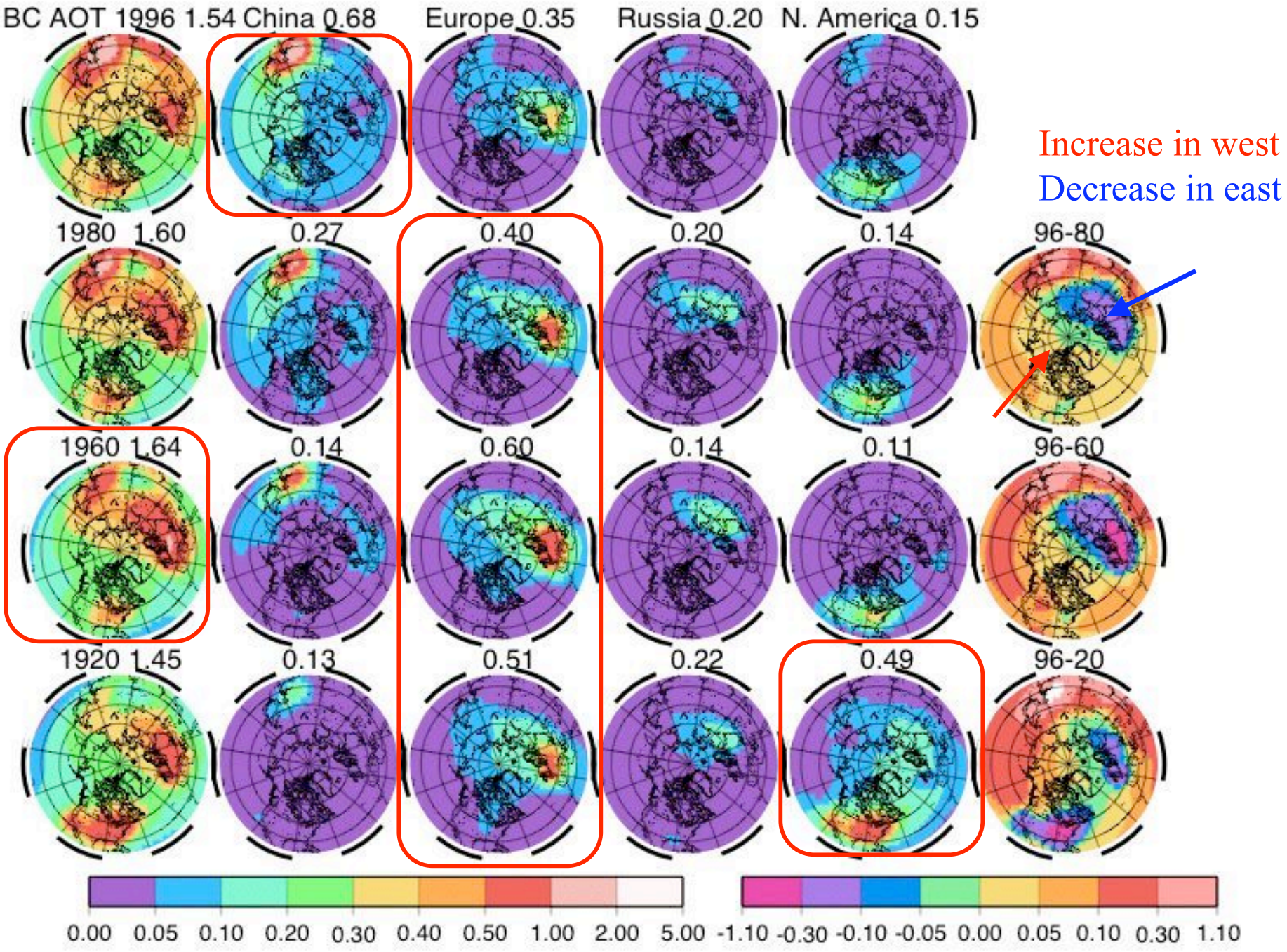


Using these emissions, we model Arctic pollution in 1920, **1960, 1980** and 1996.

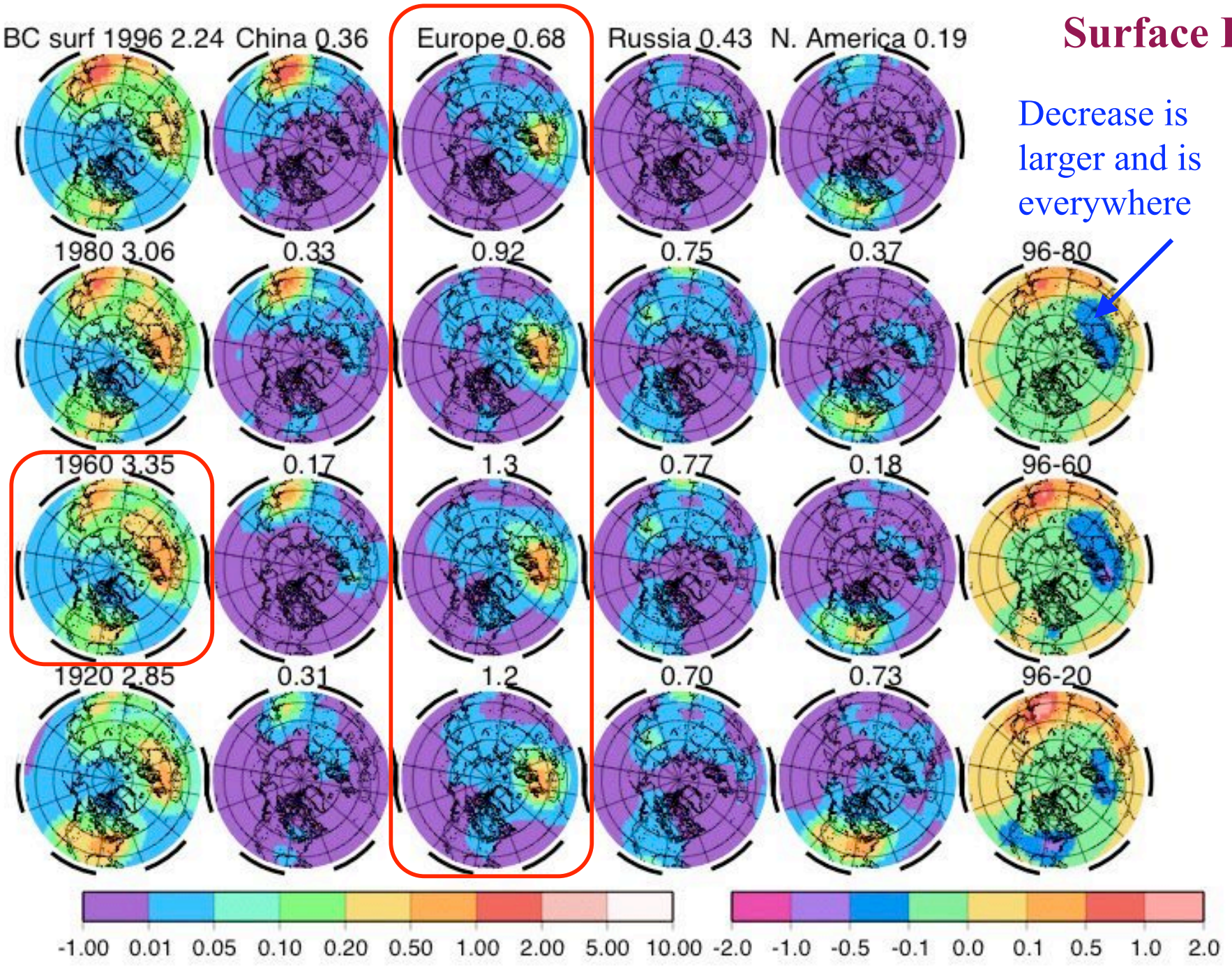
Sulfur trend check: model vs sulfur in Greenland ice core (Fischer *et al.*, 1998)



BC in Column (AOD)



Surface BC



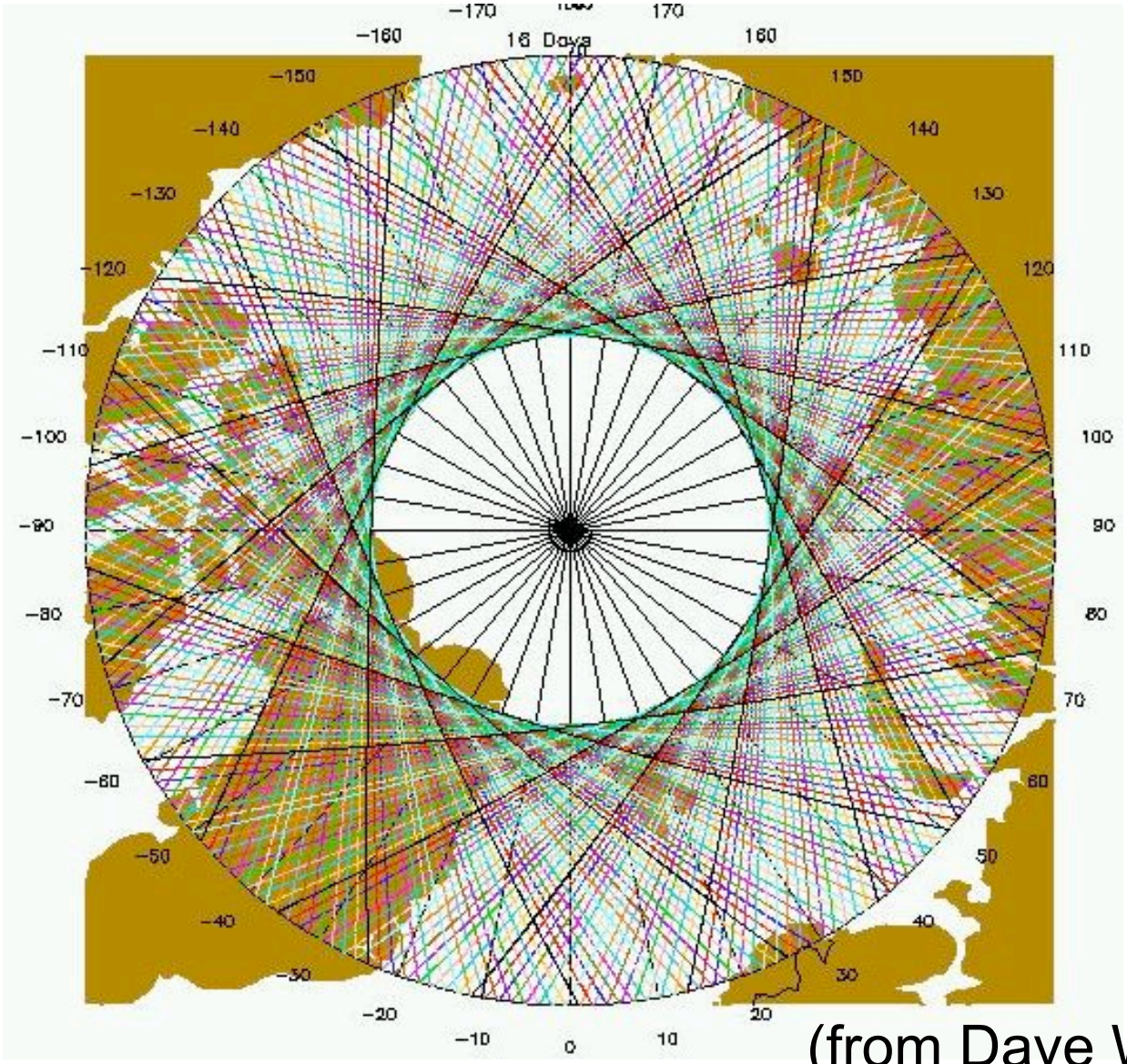
Decrease is larger and is everywhere

Model Panel Discussion: What do models need?

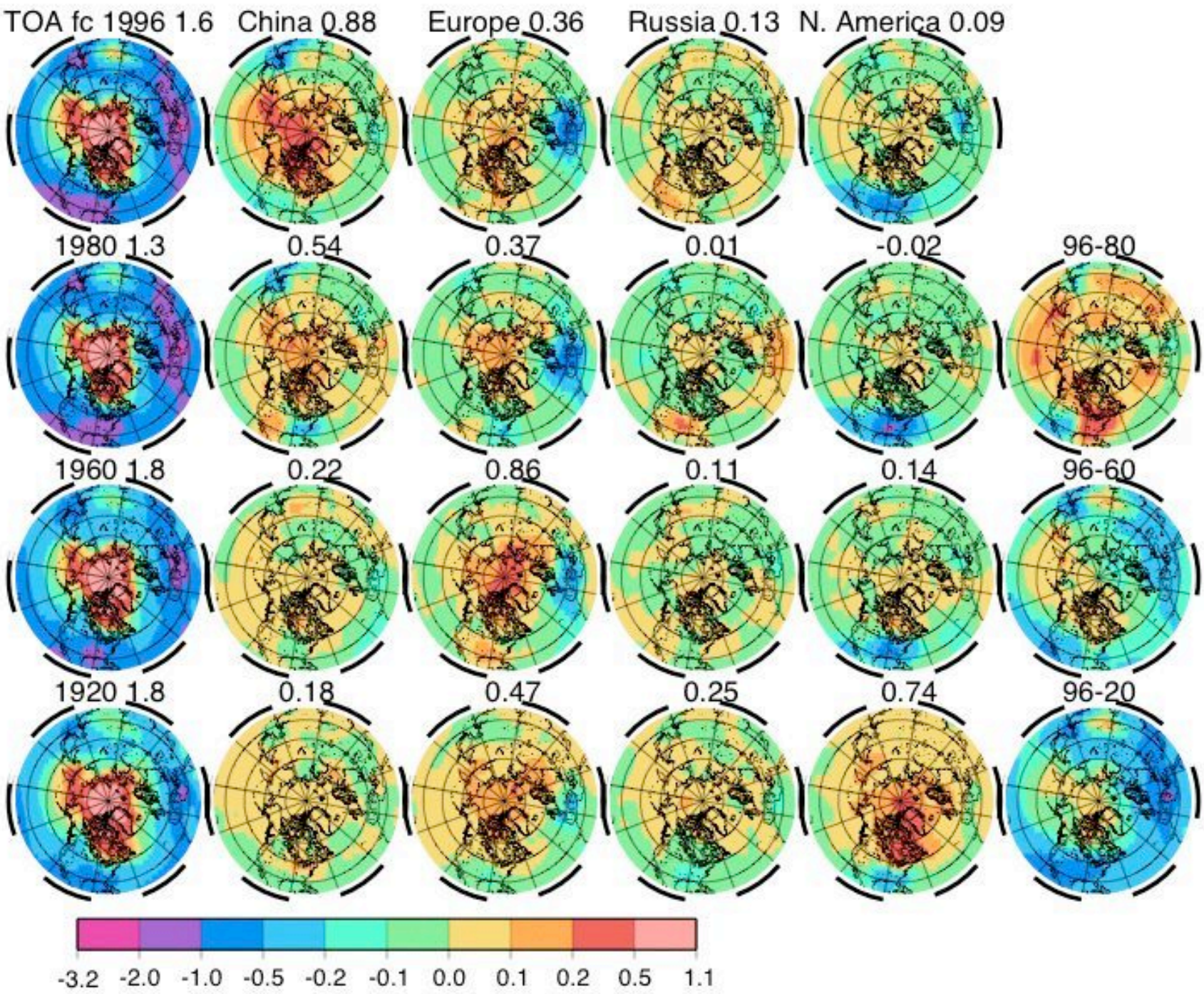
1. **Examination: Models need to be tested before doing climate simulations!**
2. **Snow and air concentrations**
3. **Information on ice/snow removal for individual species; Dry vs wet deposition?**
4. **Aerosols as a function of altitude: CALIPSO**

   Including species information: aircraft, SP2??
5. **Source attribution data (organic tracers of biomass/residential sources?)**
6. **Accurate fire emissions for individual years**

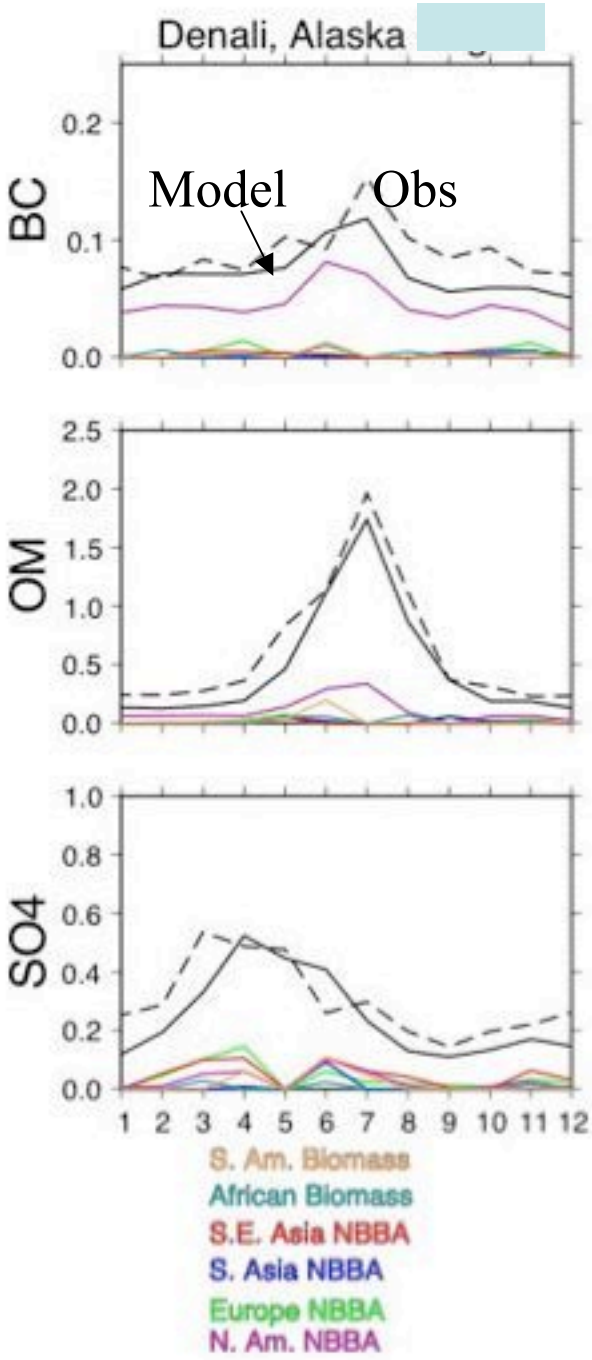
CALIOP (CALIPSO) 16-day orbit pattern



(from Dave Winker)


TOA fc 1996 1.6
China 0.88
Europe 0.36
Russia 0.13
N. America 0.09
1980 1.3
0.54
0.37
0.01
-0.02
96-80
1960 1.8
0.22
0.86
0.11
0.14
96-60
1920 1.8
0.18
0.47
0.25
0.74
96-20
-3.2 -2.0 -1.0 -0.5 -0.2 -0.1 0.0 0.1 0.2 0.5 1.1

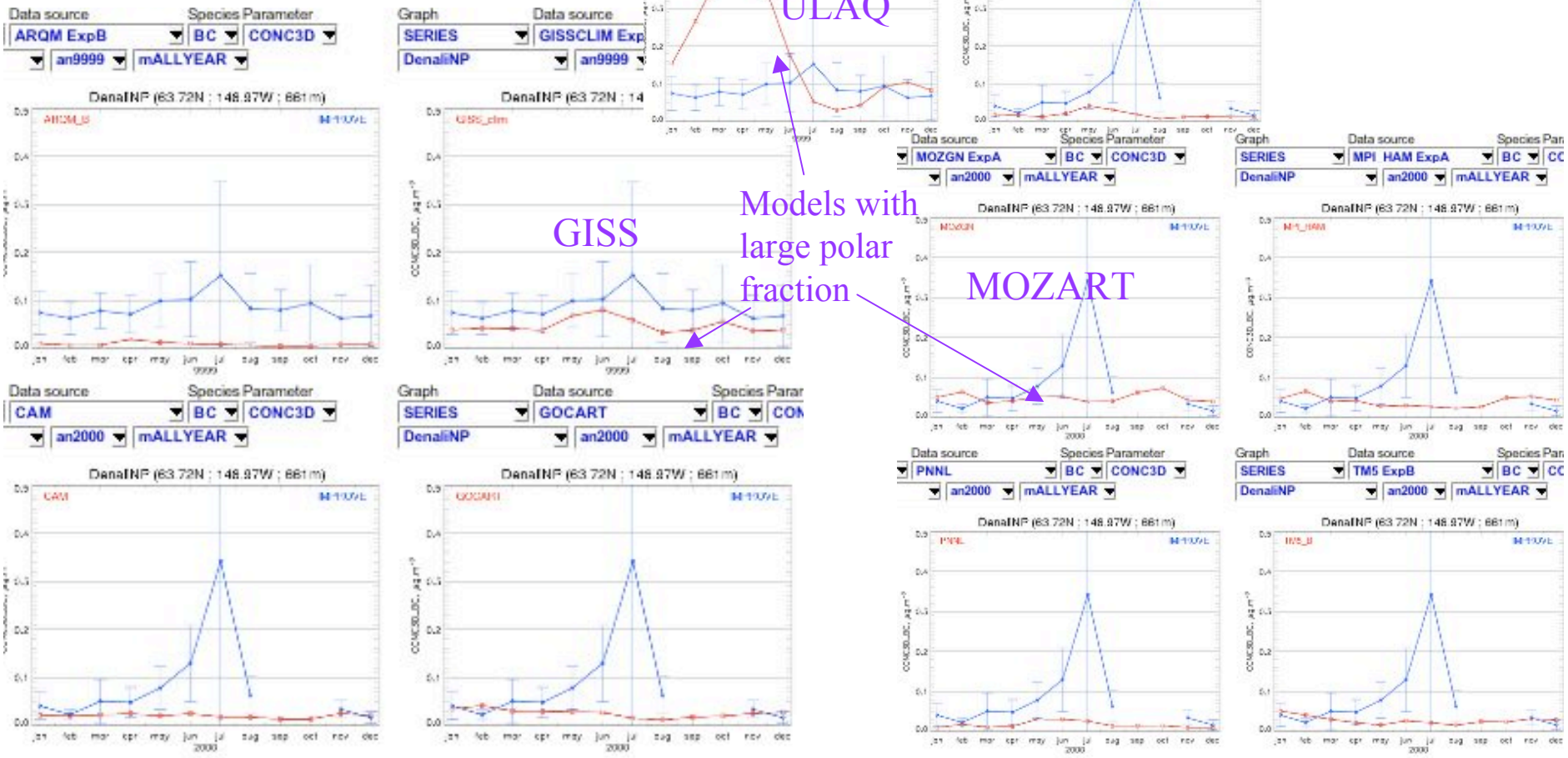
GISS in Denali, Alaska



AEROCOM models in Denali Black Carbon

Red = model

Blue = obs surface conc



AEROCOM models in Denali Black Carbon

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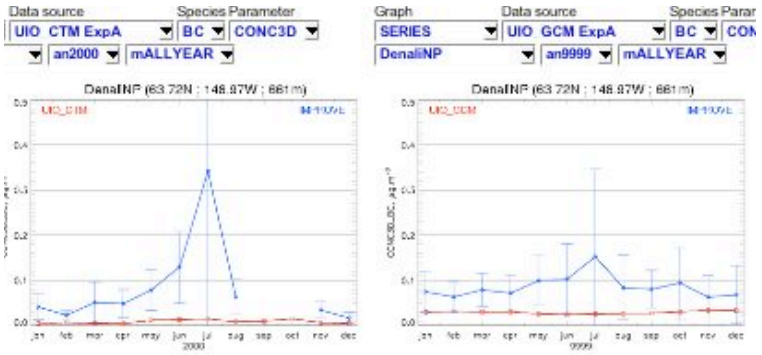
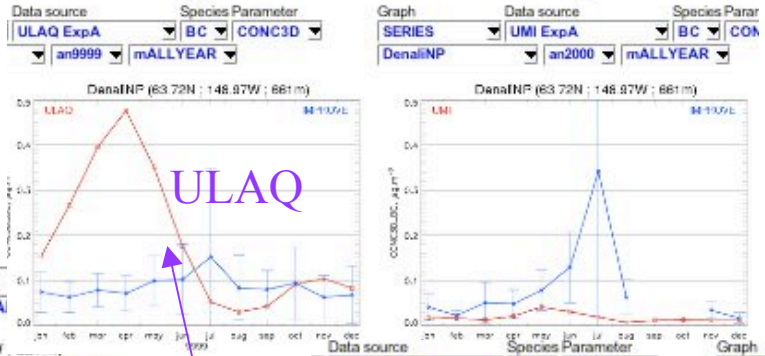
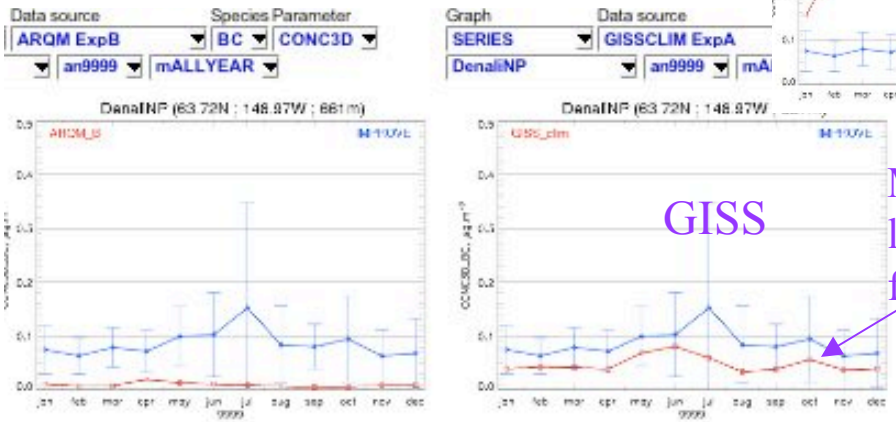
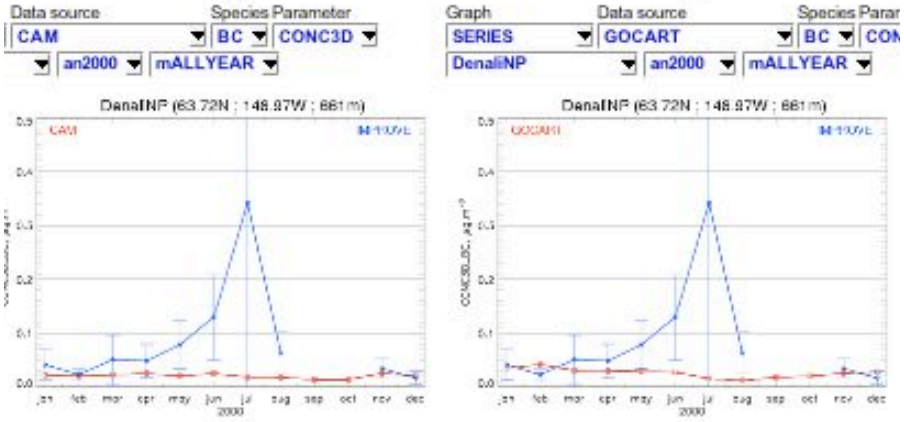
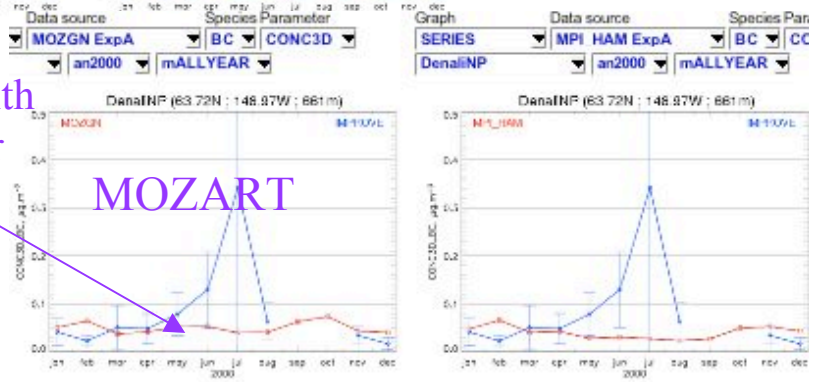


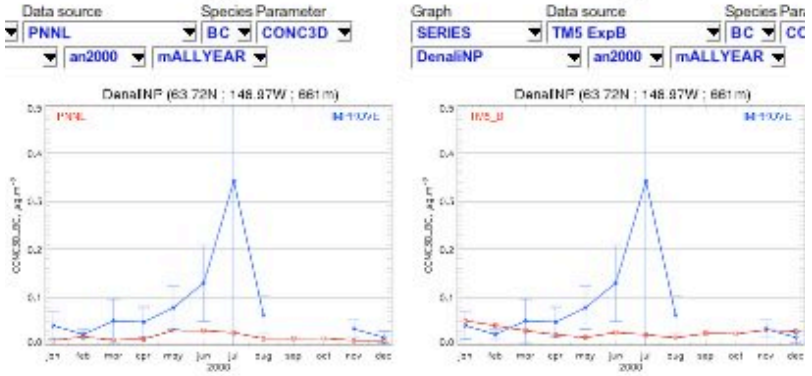




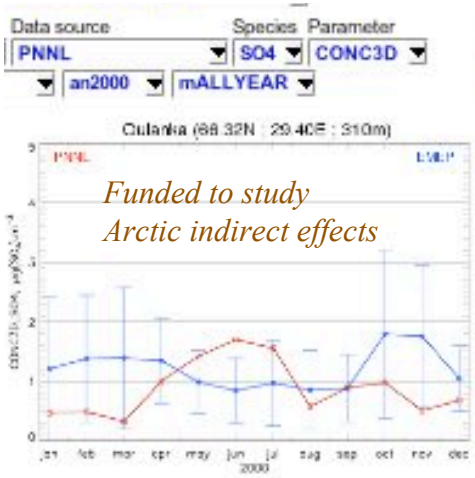


Models with large polar fraction

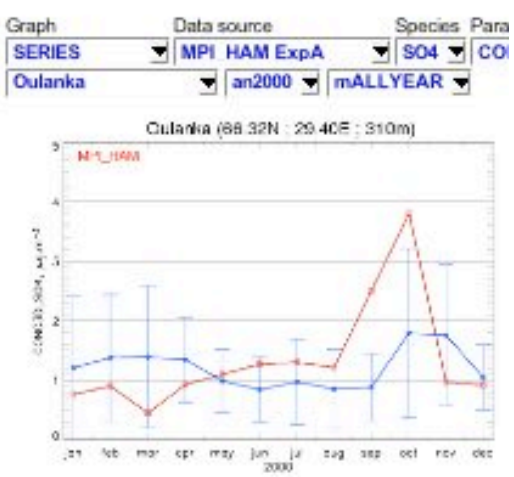


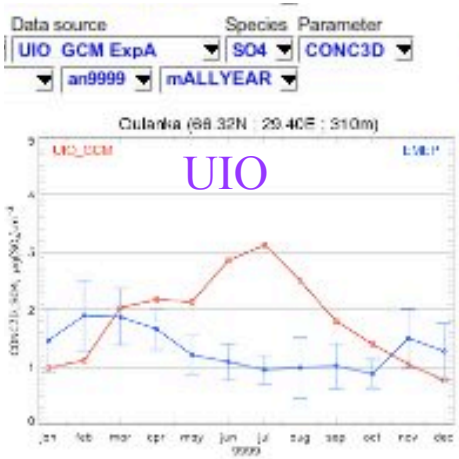


AEROCOM models in Oulanka, Norway sulfate



Funded to study Arctic indirect effects





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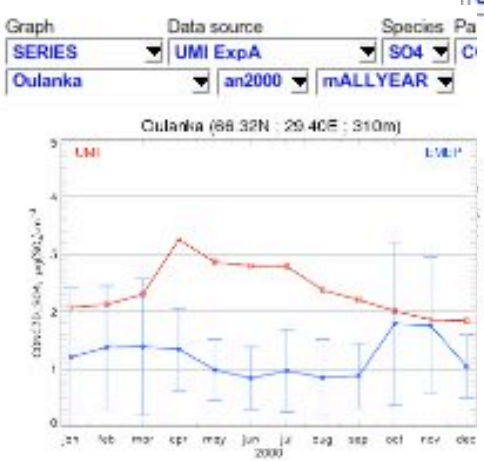
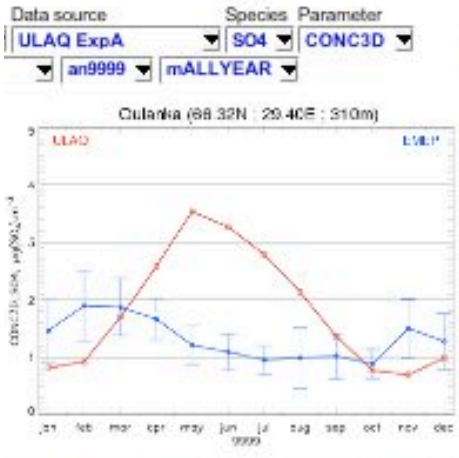
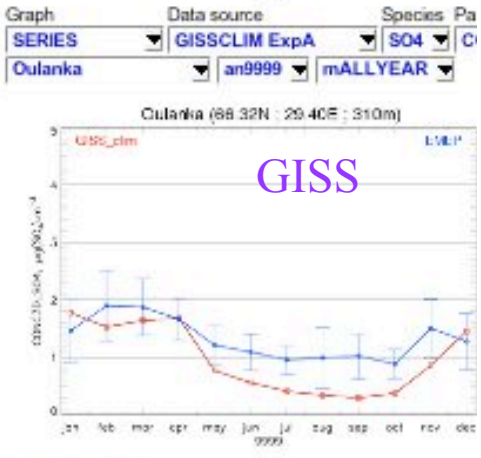


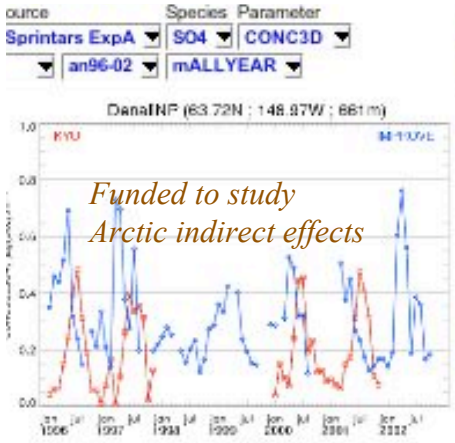
MOZART





GISS

AEROCOM models in Denali, Alaska sulfate



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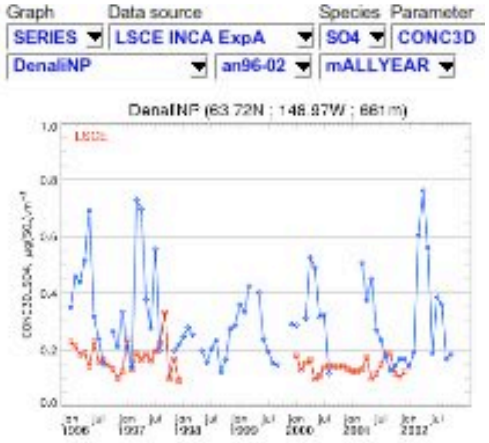

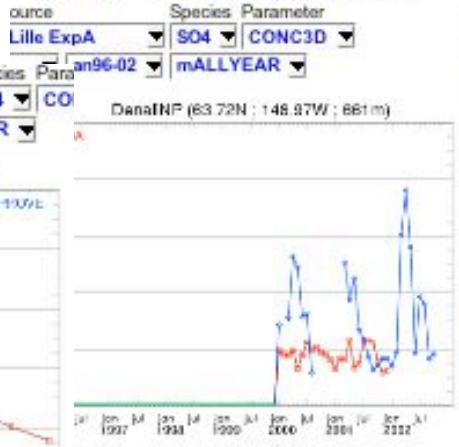

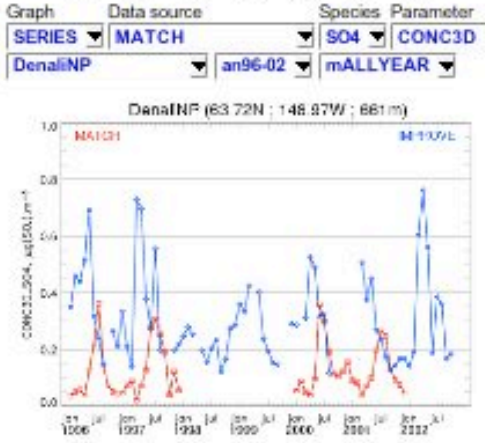

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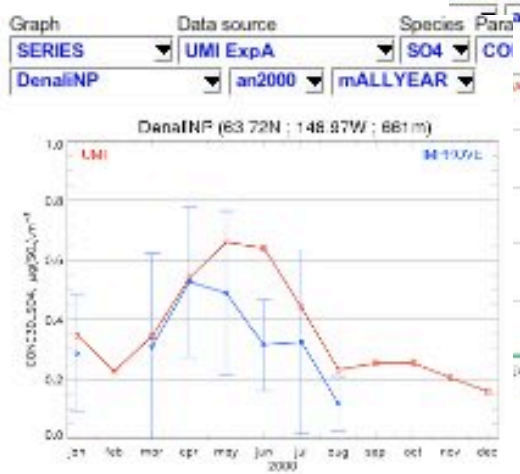
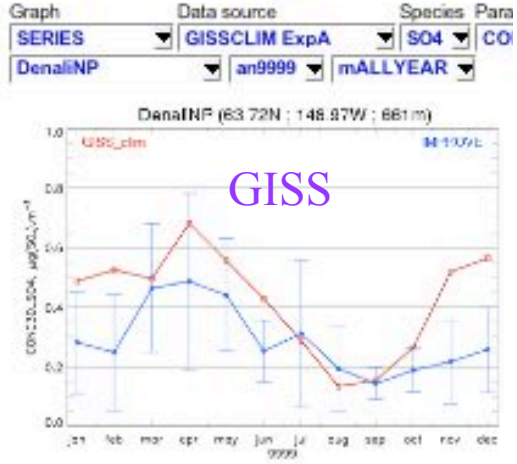
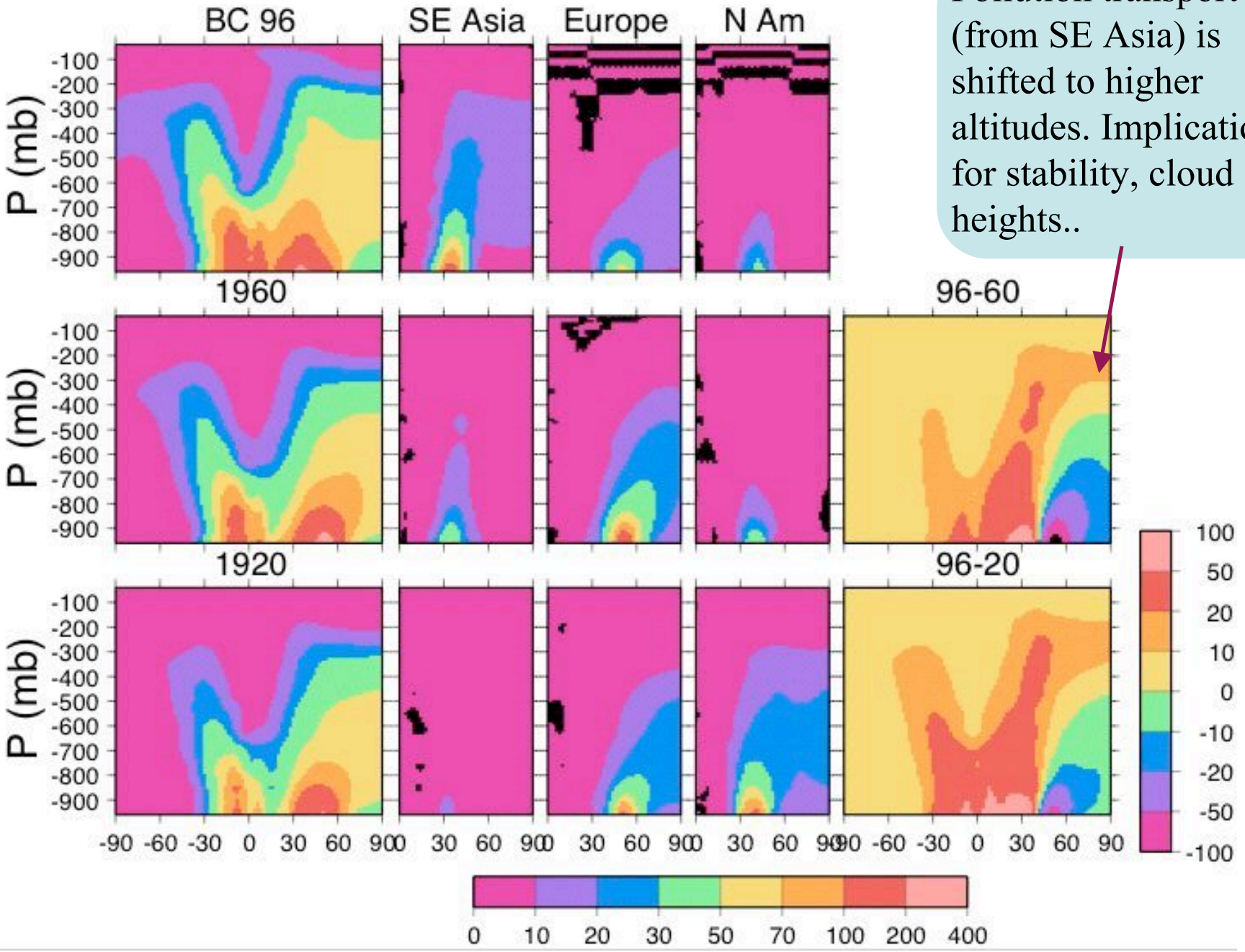


ULAQ



GISS

Evolution of Arctic **BC**:1920 - 1996



Pollution transport (from SE Asia) is shifted to higher altitudes. Implications for stability, cloud heights..